

So You Want to Build a Wind Farm

How to get started

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10/30/12

Energy Efficiency First



- Make homes, workplaces and communities energy efficient thru weatherization and efficient lighting/appliances.
- Because of PCE, residential rate payers won't see much benefit from a wind farm.
- Once efficient, pursue renewable energy. Otherwise, money is wasted to build an oversized system.
- EE makes economic sense – faster payback (2-3 years vs. 15-20 for wind projects in rural Alaska) than any other option and immediate reduction in monthly heat and electric bills.

How windy is it, really?

- Anecdotal weather data or observations can be deceptive. For example:
 - A few windy days get some people wanting to install wind turbines.
 - It only takes one rainy day for people to think that fire danger is reduced.
 - A short cold spell can fool us into not seeing an overall warming trend.
 - Our bodies can sense the weather, but we need to collect data to understand the long-term climate.
- What matters is the wind speed throughout the course of an entire year.

How windy is it, really?

- The formula for wind power is:

$$\text{Power} = 0.5 \times \text{Rotor Swept Area} \times \text{Air Density} \times \text{Velocity}^3$$

- Thus, doubling the wind speed from 3 meters/sec to 6 meters/sec **increases the power by 8X.**
- 7 meters/sec wind speed adds another 58% increase in wind power over 6 meters/sec.

How windy is it, really?

- Measure the wind for a minimum of one year.

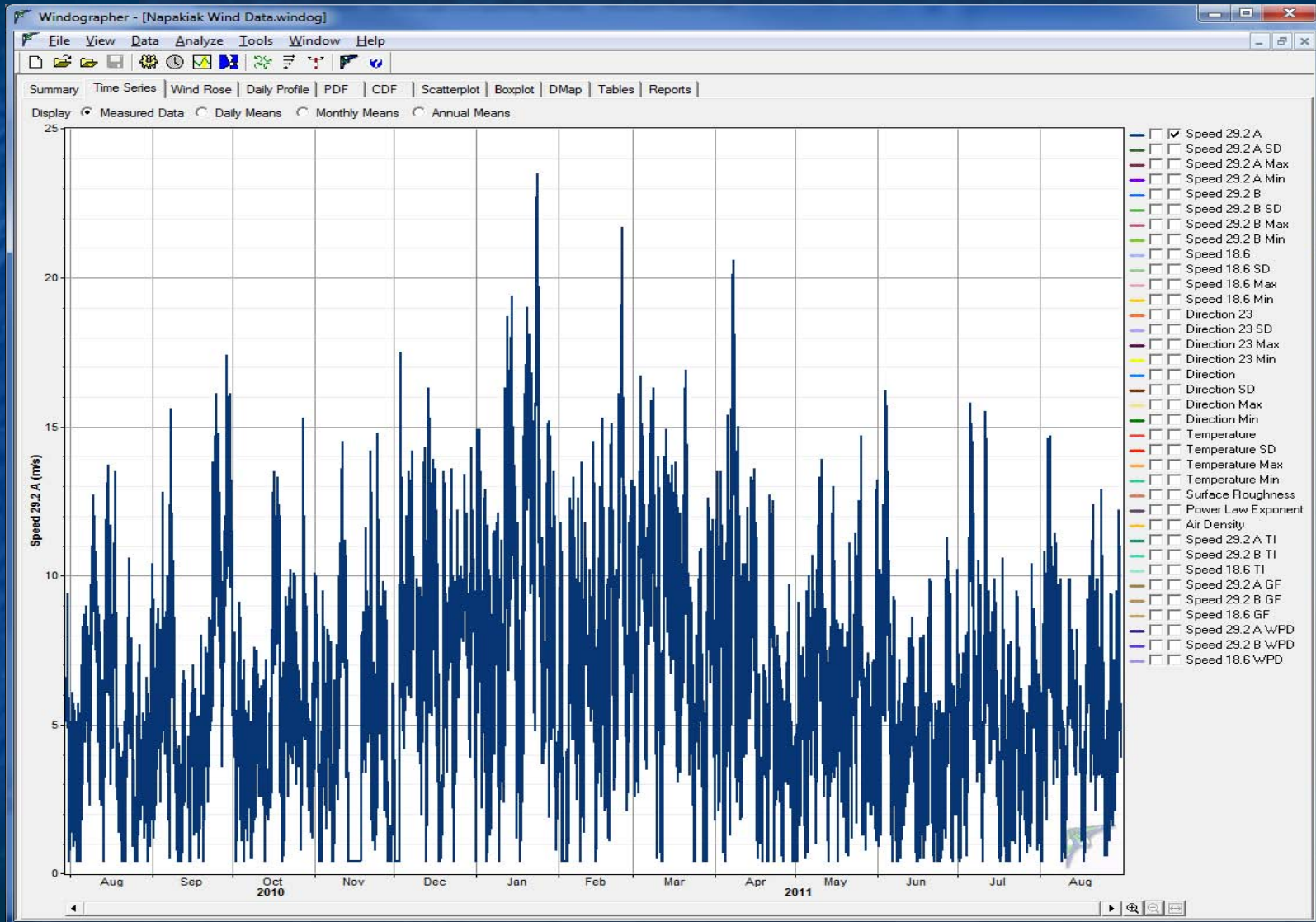


How windy is it, really?

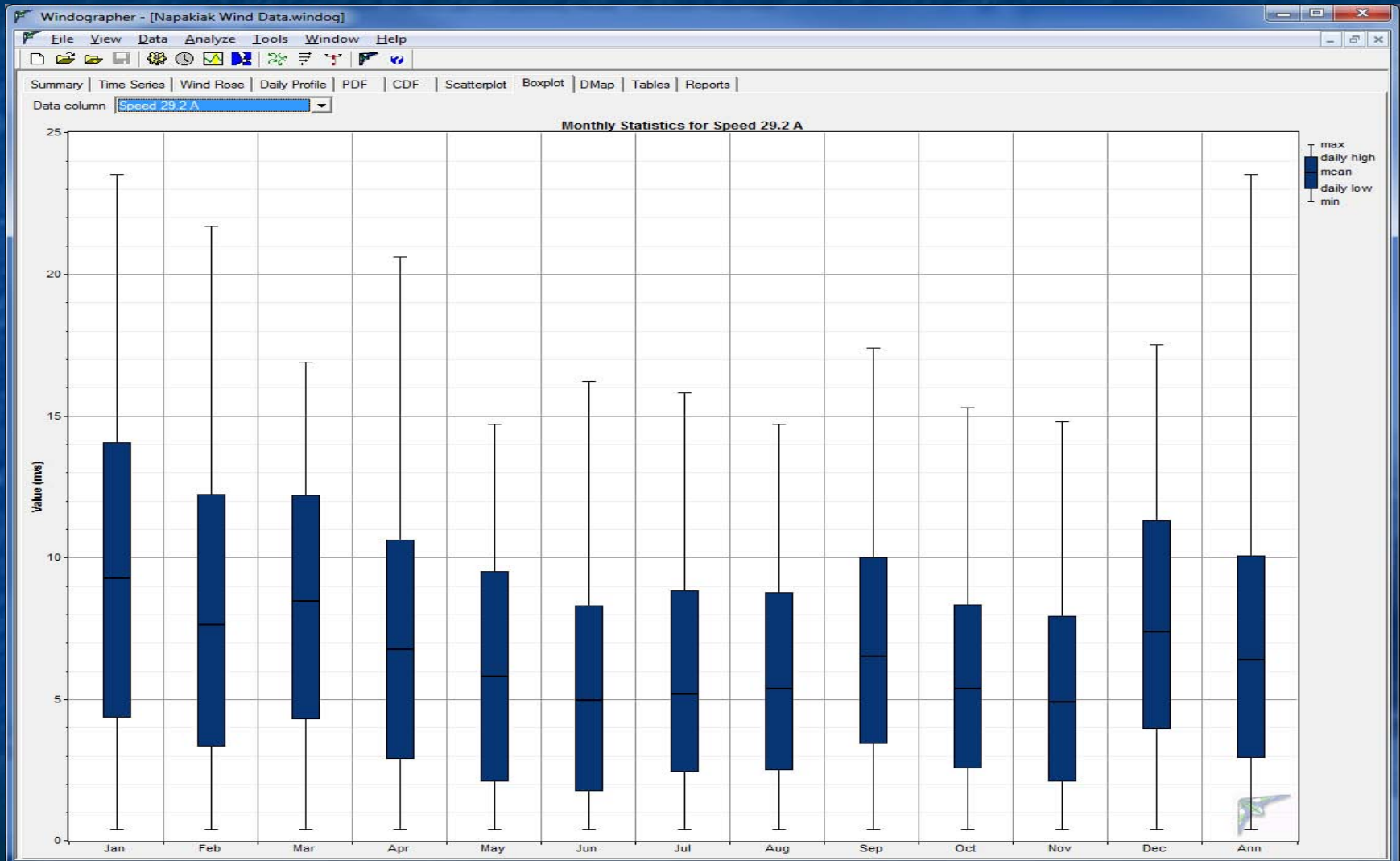
- Met towers require a permit from the FAA and consultation with US Fish & Wildlife, State Historic Preservation Office and possibly other agencies.



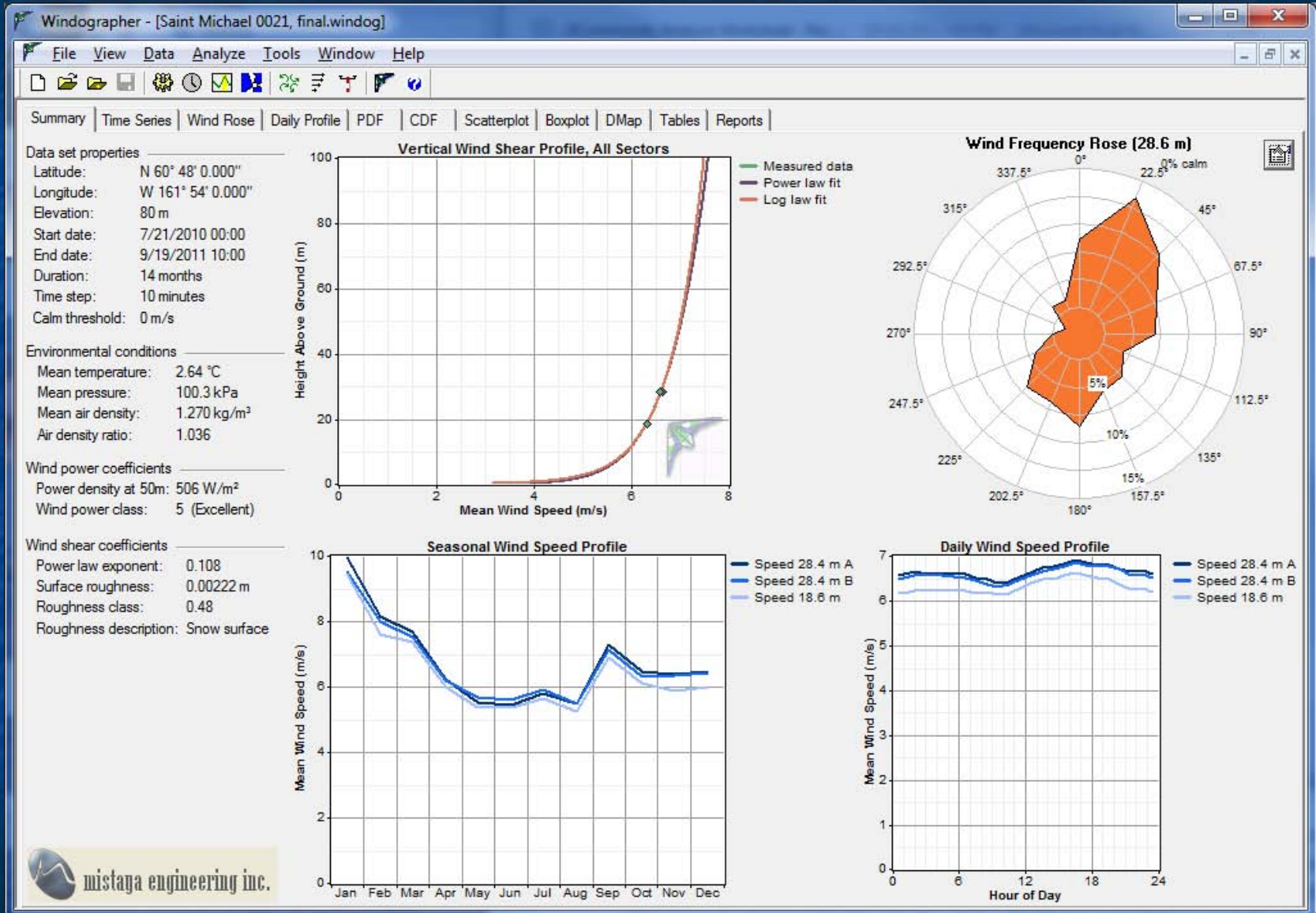
What the raw data shows



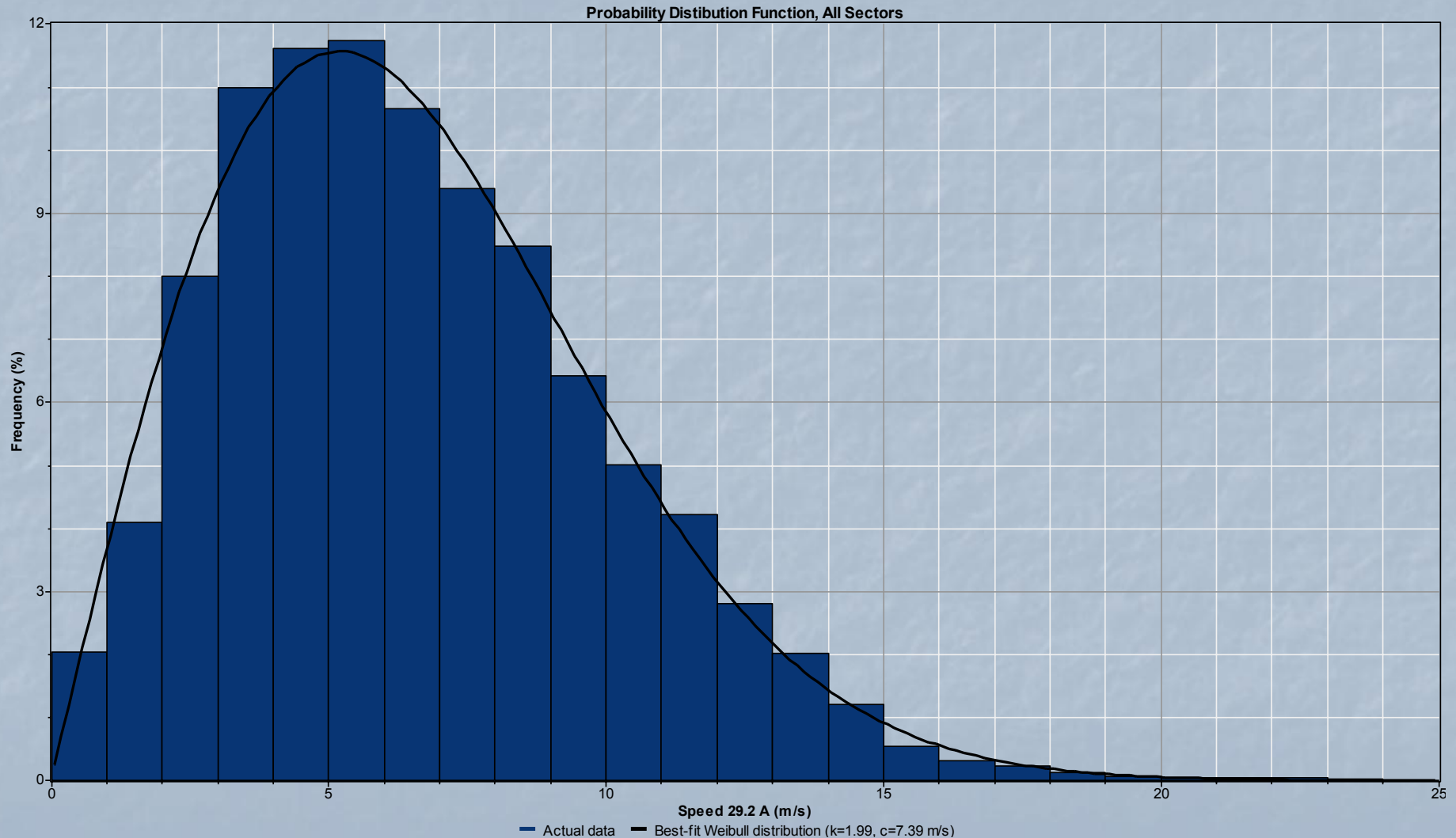
Summarize data into information



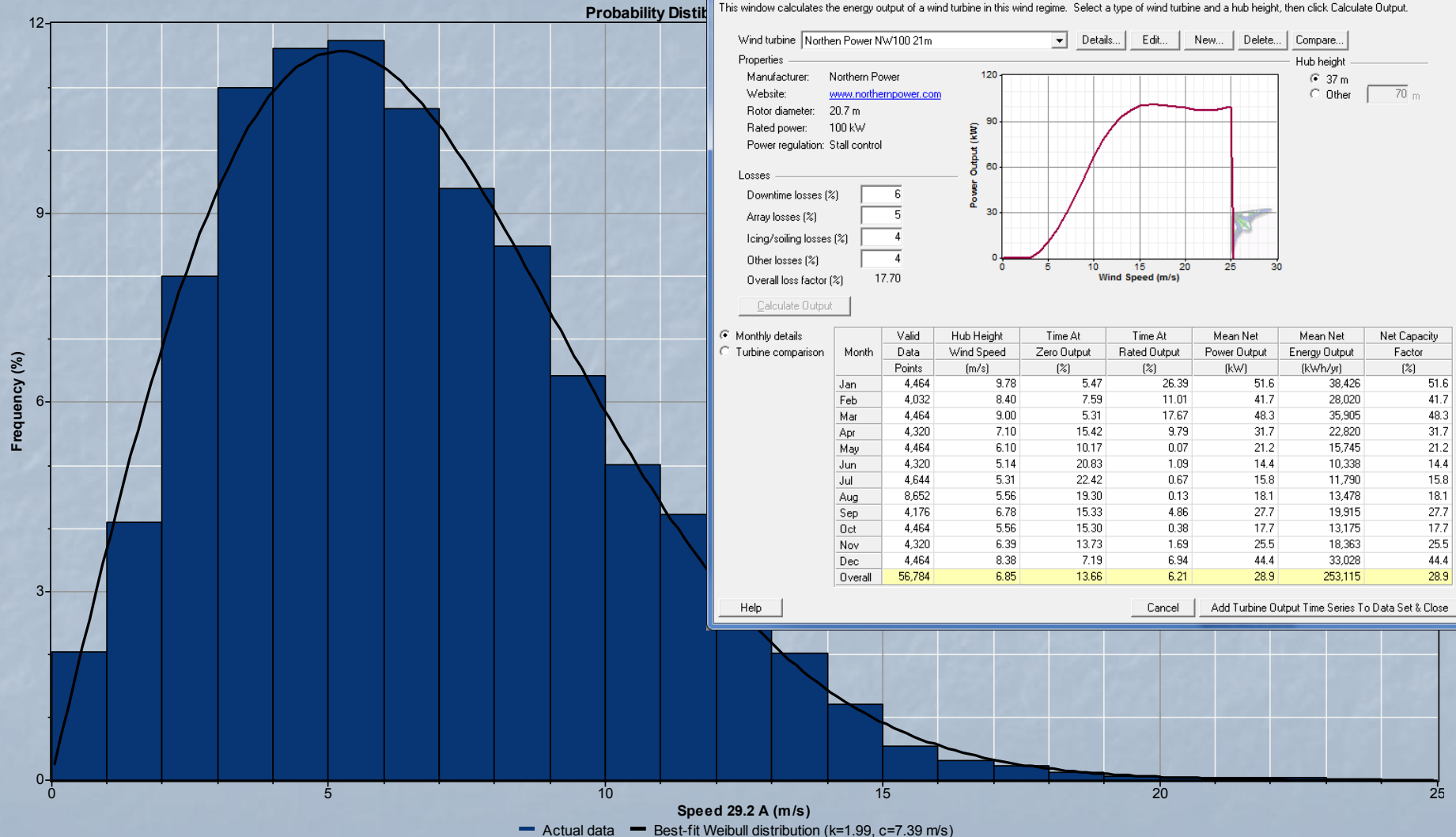
Summarize data into information



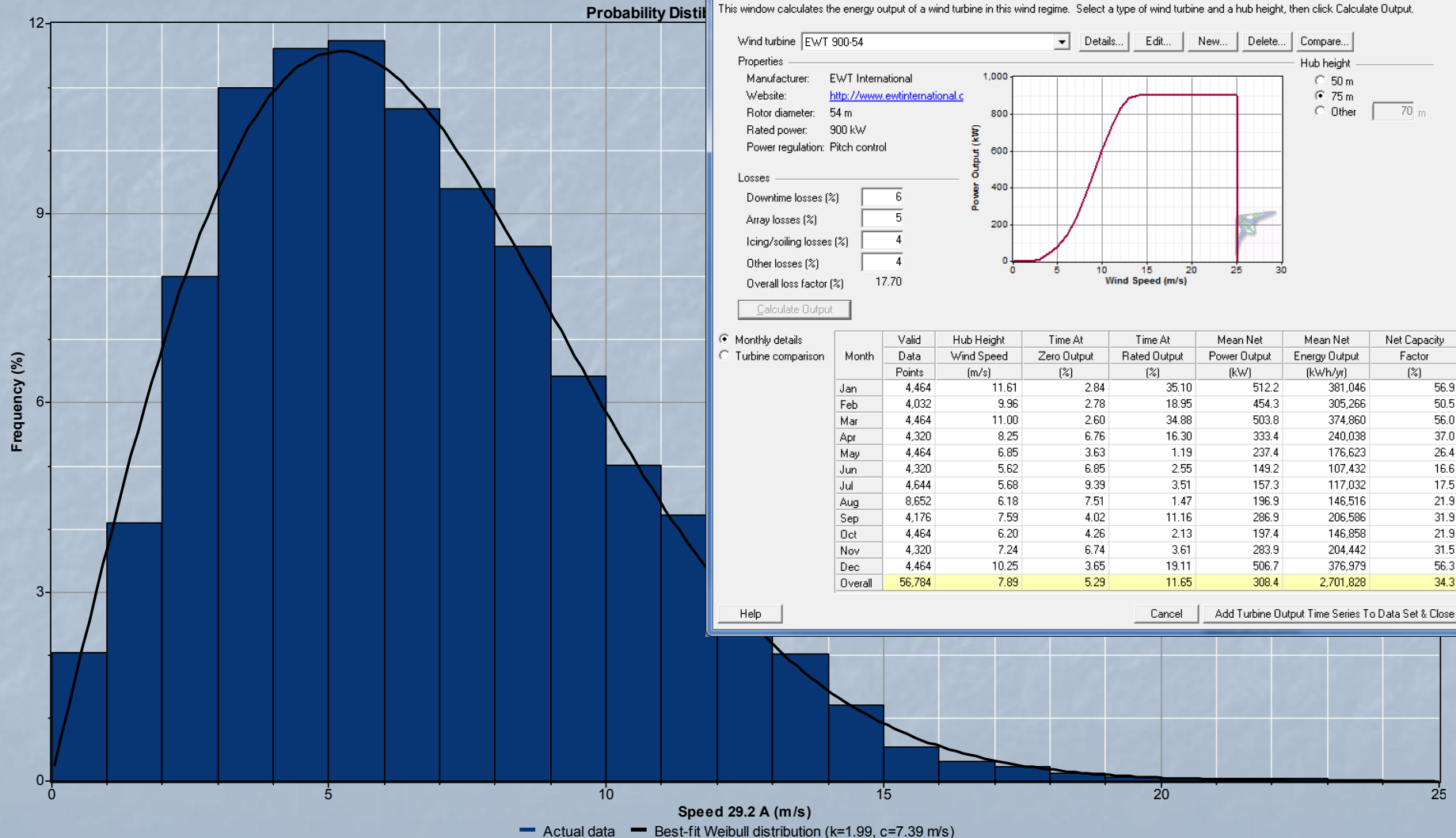
Shape of the wind distribution



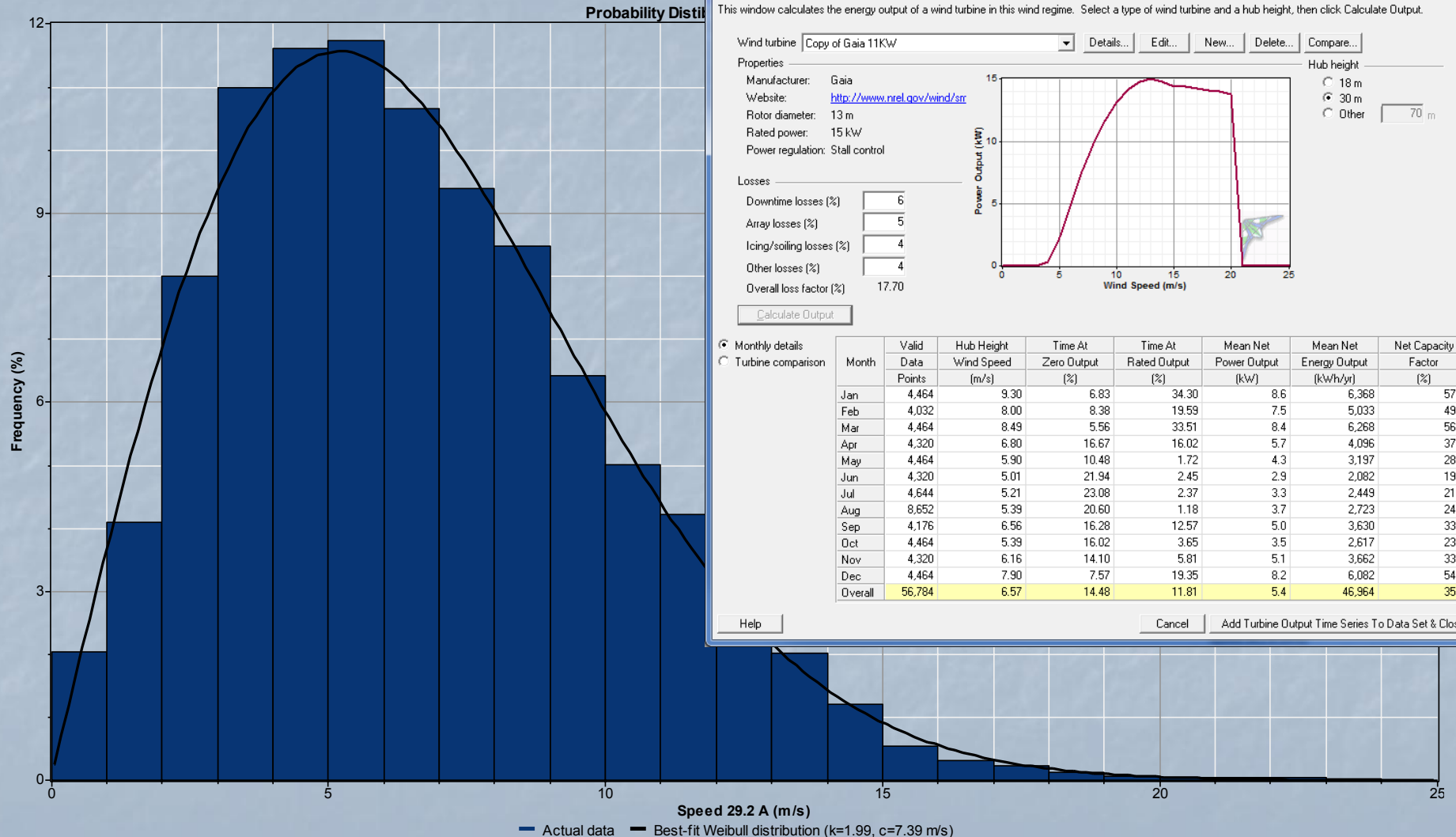
Wind distribution vs. turbine power curve



Wind distribution vs. turbine power curve

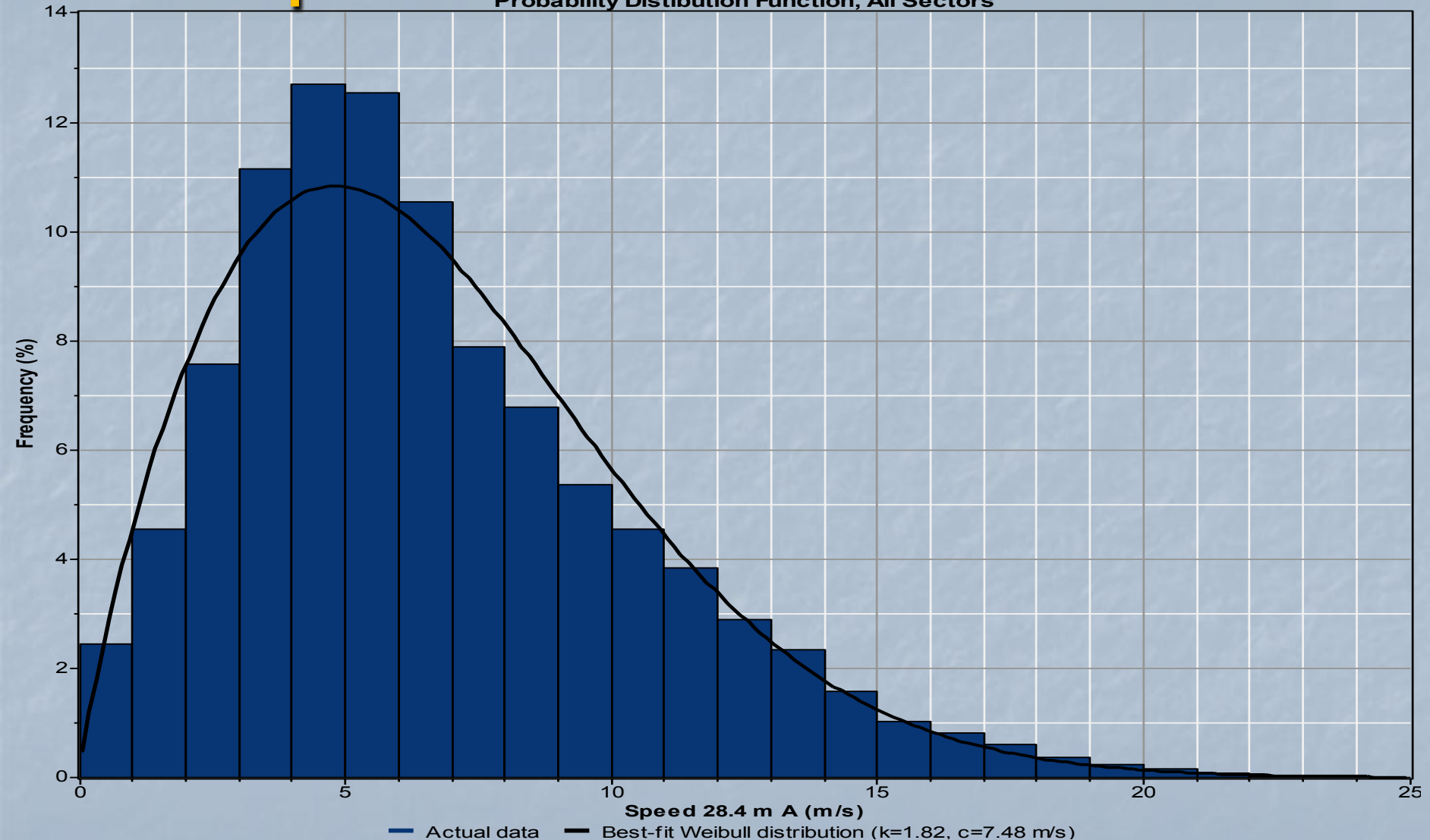


Wind distribution vs. turbine power curve



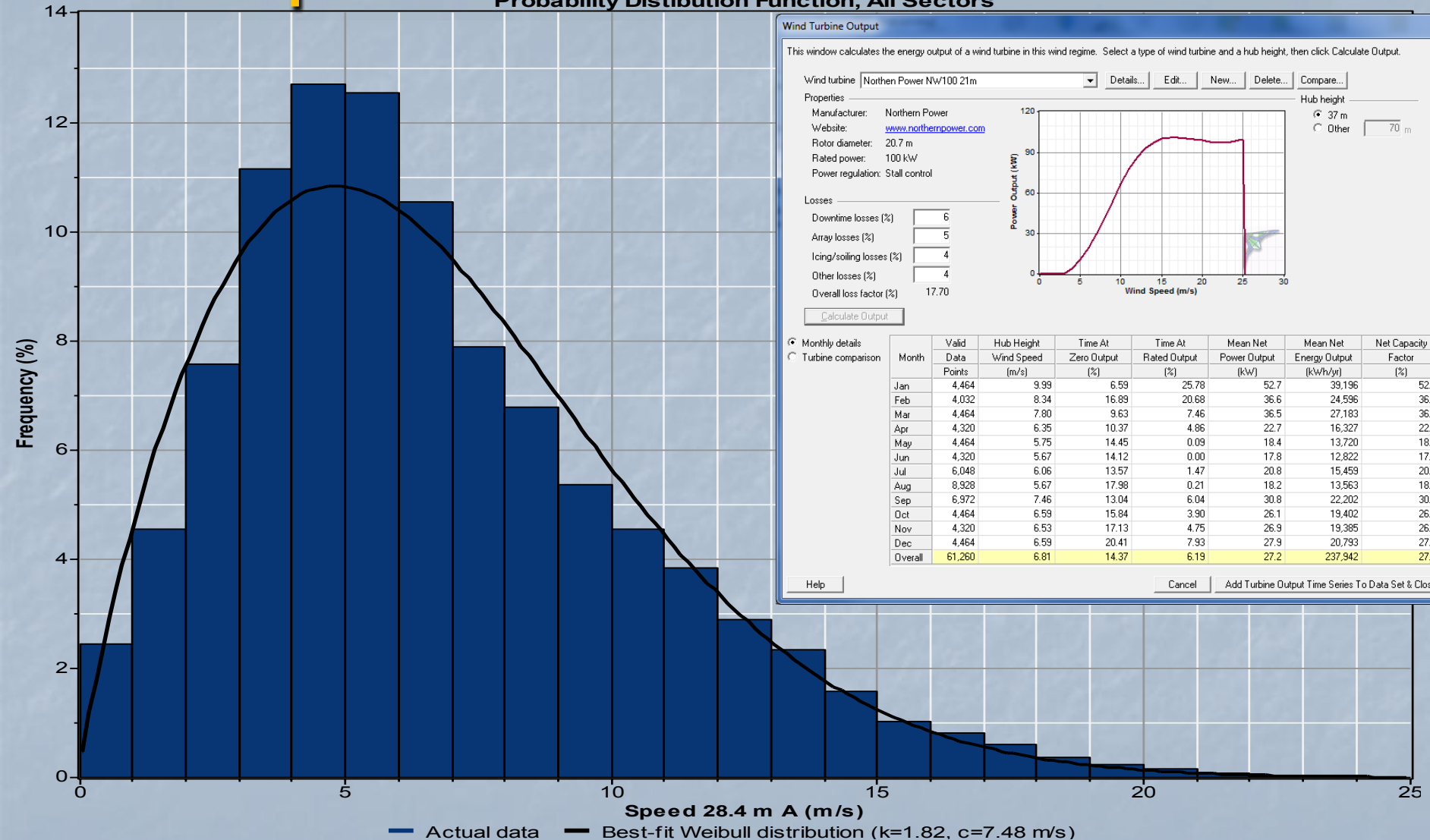
Shape of the wind distribution

Probability Distribution Function, All Sectors



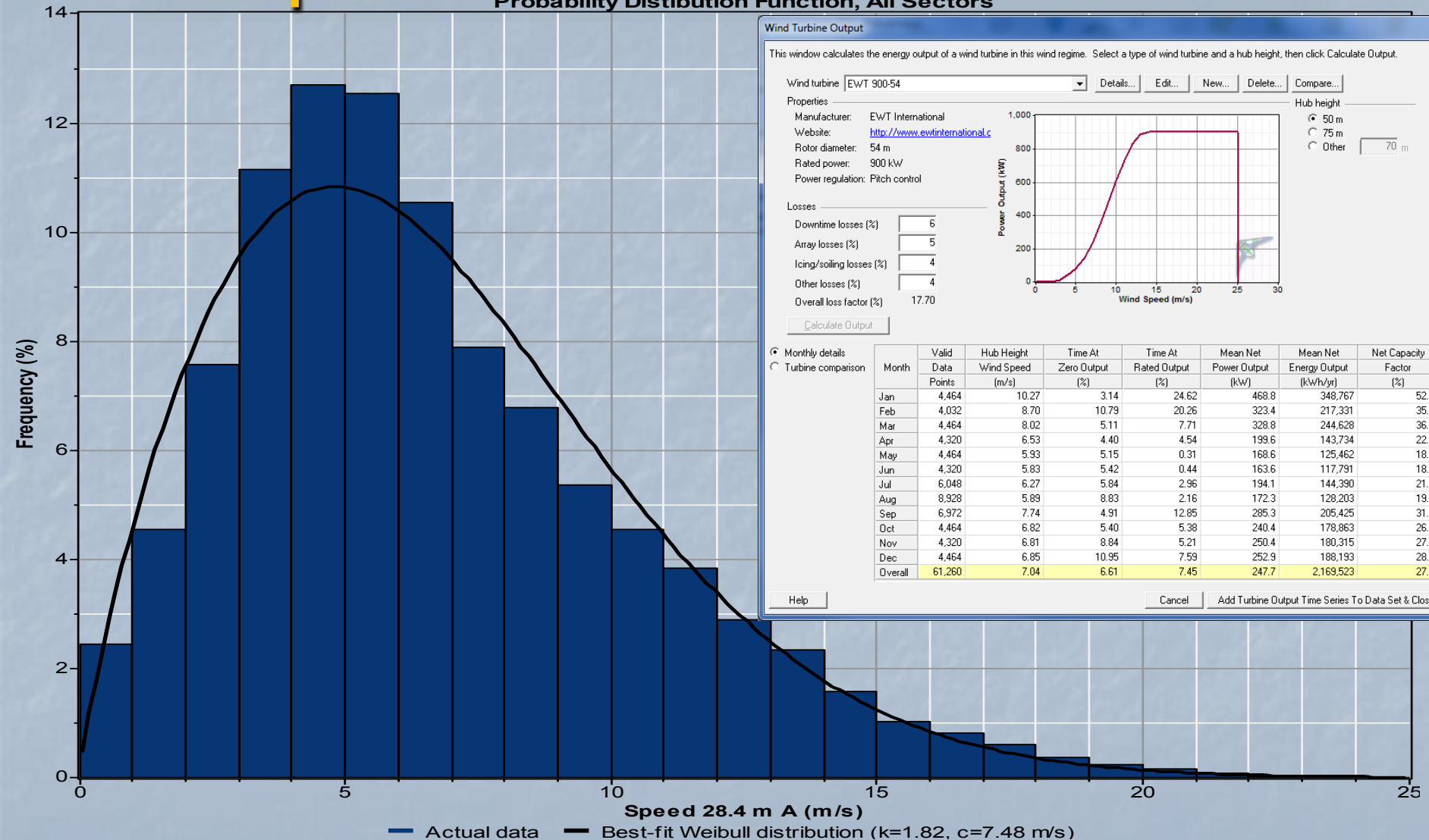
Shape of the wind distribution

Probability Distribution Function, All Sectors



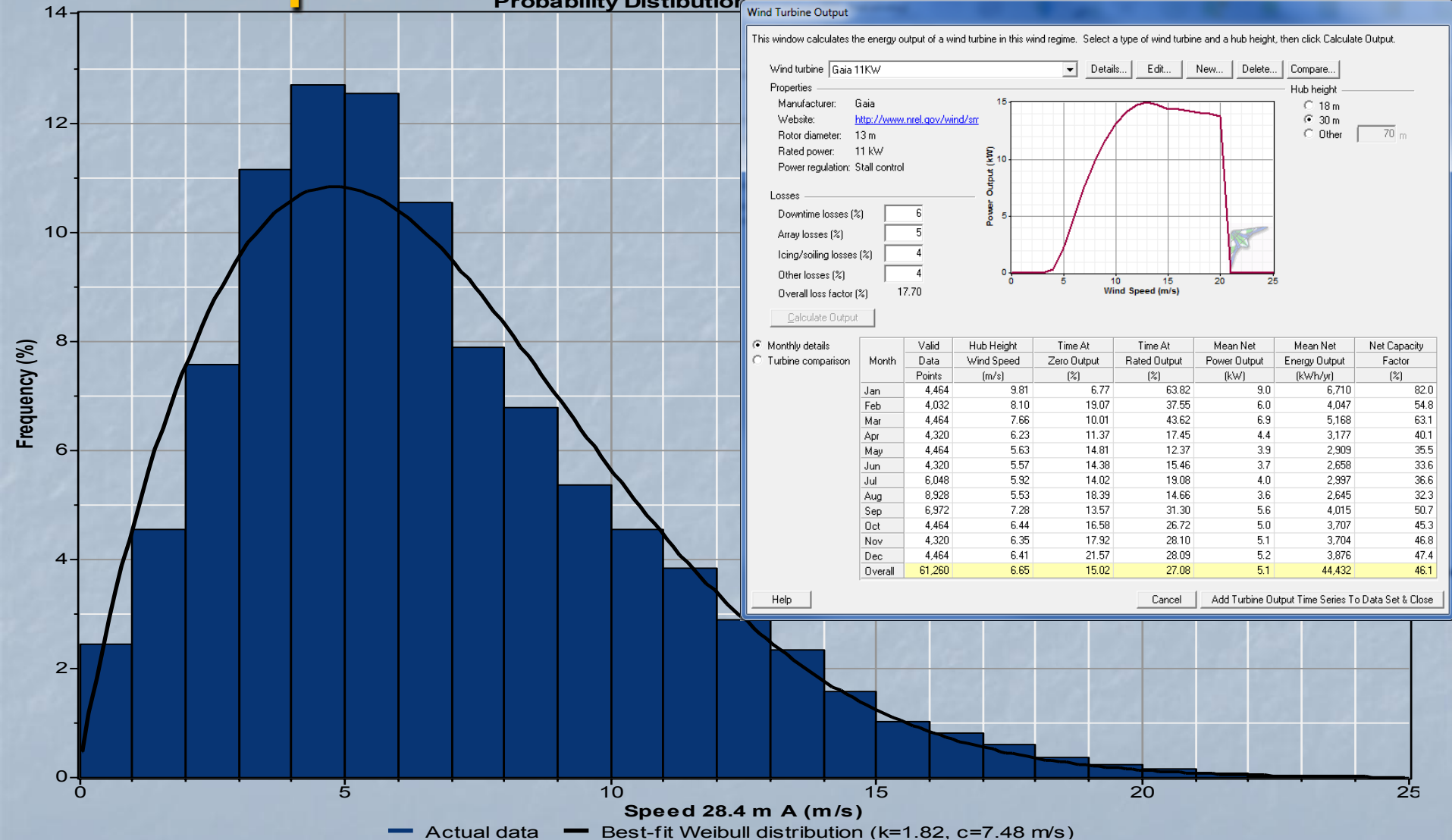
Shape of the wind distribution

Probability Distribution Function, All Sectors



Shape of the wind distribution

Probability Distribution



Stop! Do you really want to attempt this on your own?

- Village and utility must be partners - MOU.
- Contact your regional Native corporation to see if they have engineering resources or can help fund the project.
- Request proposals (RFP) from engineering firms, environmental permitting consultants and project management companies.
- Even experienced utilities like AVEC, Kodiak Electric and GVEA partner with consultants.

Can your existing electrical distribution system support wind technology?

- Do you have newer diesel gensets with fast, electronic injection controls or mechanical governors?
- Are your gensets sized so that you can run at optimum fuel efficiency both when the wind is blowing and when it's calm?
- Are your distribution lines, transformers and meters up to code?
- Are your phases balanced?
- If you can't answer "yes" to all of these questions, you could save more money by fixing your existing power system.

Can your existing electrical distribution system support wind technology?



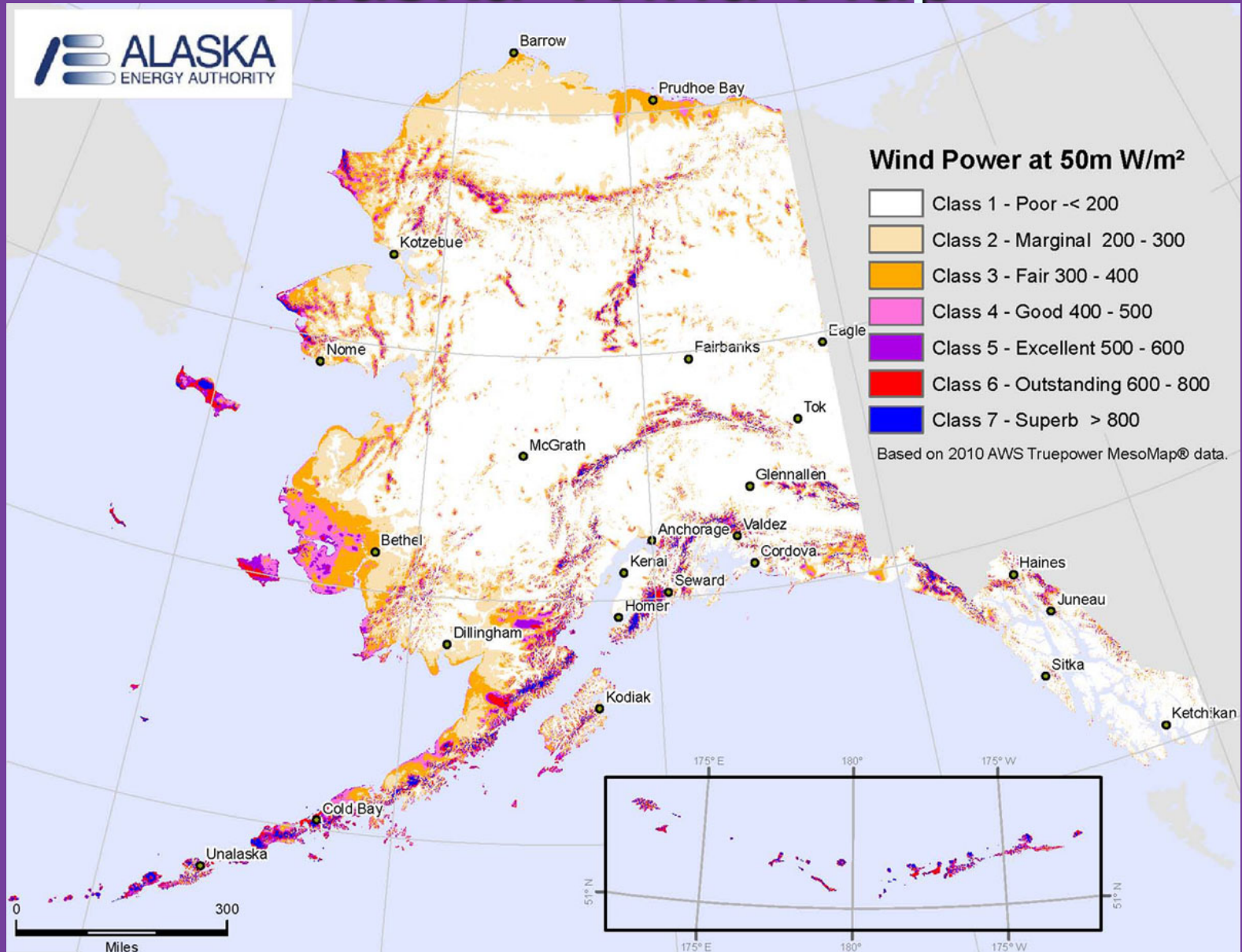
Can your existing electrical distribution system support wind technology?



Pick a potential site

- Pick a site that is close to the existing power distribution grid.
- Site should have little or no tall vegetation and no buildings to block prevailing winds.
 - Site met tower at a minimum distance that is 5X the height of any obstructions.
- Consult AEA's Energy Pathway document (<ftp://ftp.aidea.org/AlaskaEnergyPathway/2010EnergyPathway8-12Press.pdf>), the Community Database (<ftp://ftp.aidea.org/2010AlaskaEnergyPlan/2010%20Alaska%20Energy%20Plan/Community%20Deployment%20Scenarios/>) and the state wind resource maps.

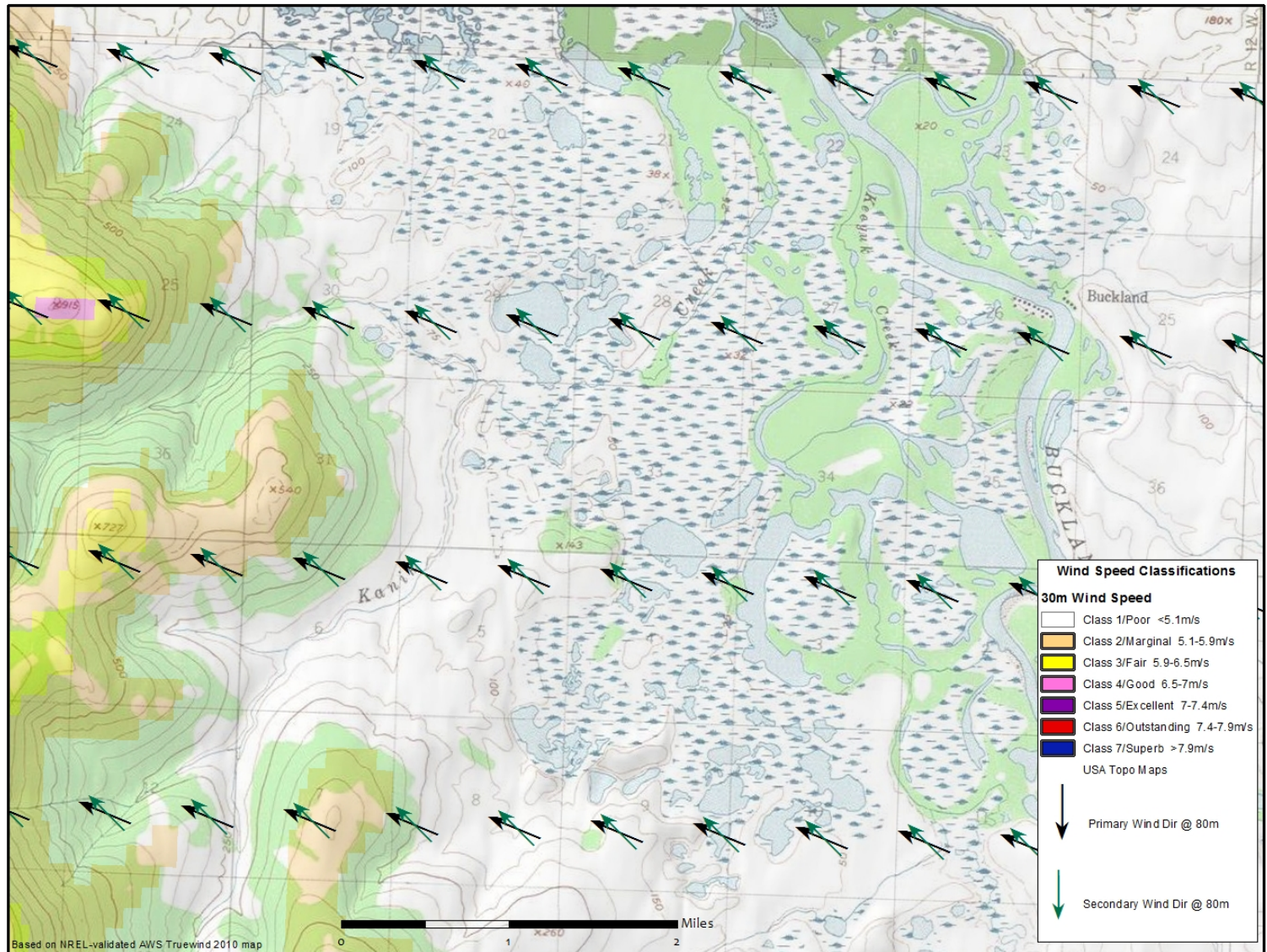
Alaska Wind Map



Wind Resource Maps

Buckland

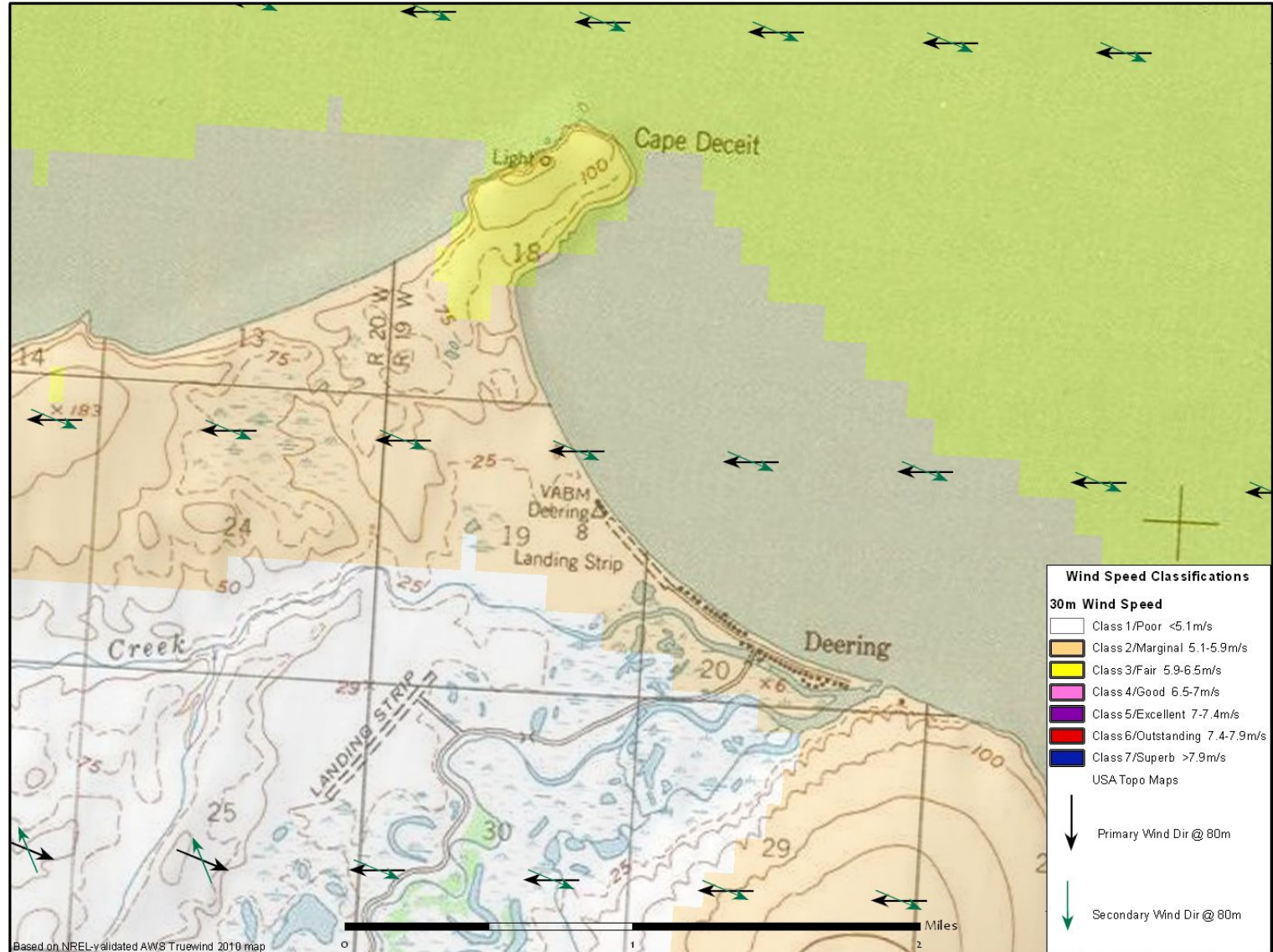
AEA - Alaska Wind Speed Map



Wind Resource Maps

Deering

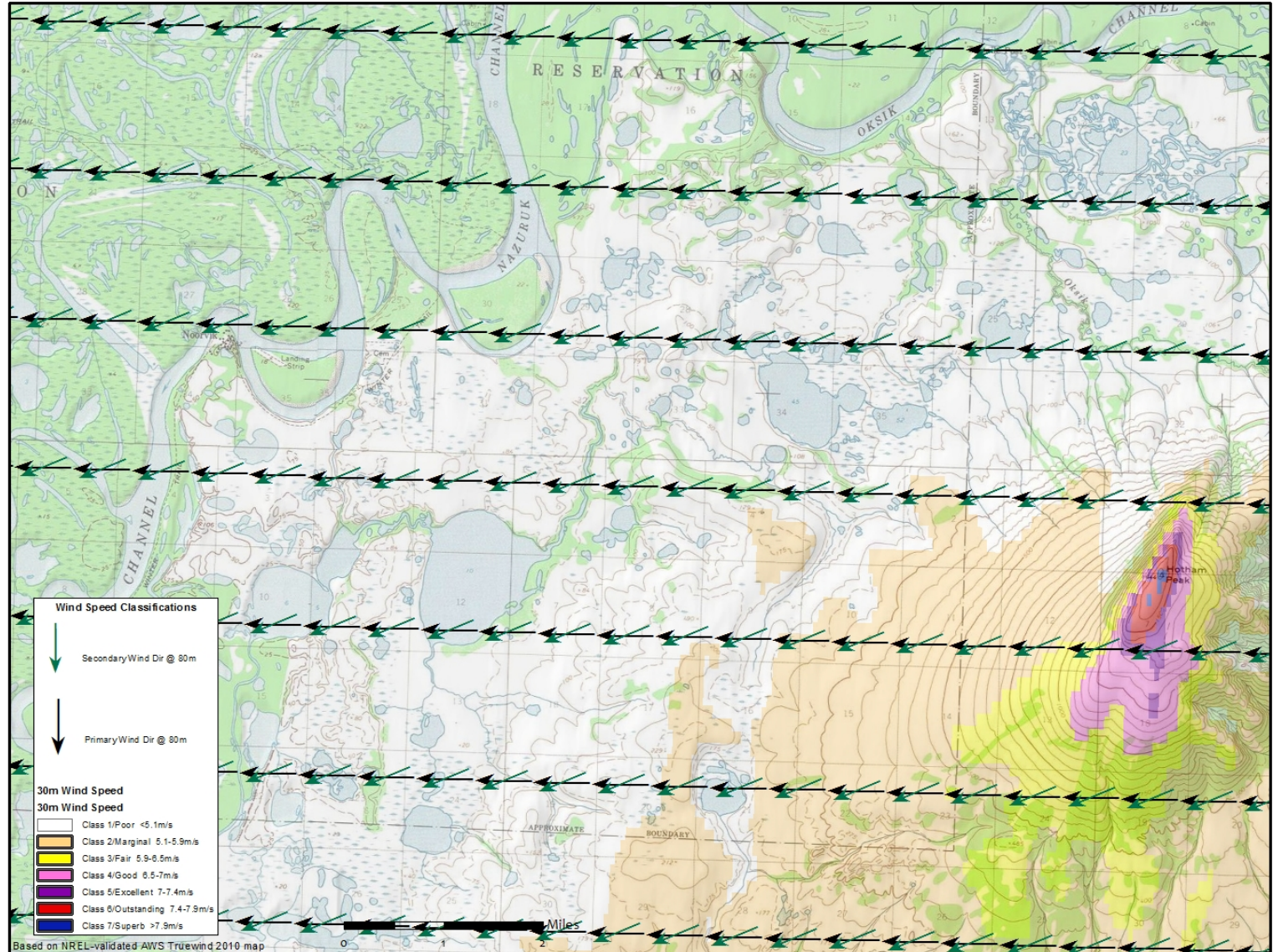
AEA - Alaska Wind Speed Map



Wind Resource Maps

Greater
Noorvik

AEA - Alaska Wind Speed Map

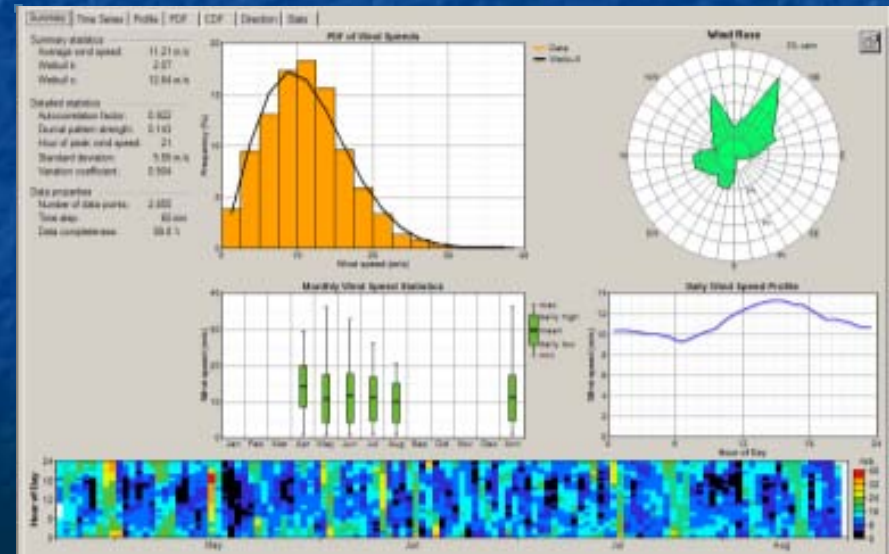


Wind Classifications

- Class 1/Poor: Pursue options other than wind
- Class 2/Marginal: High costs of development in rural Alaska prevent an economical project.
- Class 3/Fair: A large project on the Railbelt may be cost effective. Remote village projects may have a payback longer than the 20-year life of wind turbines.
- Class 4/Good: A well-designed project will have a payback of 15-20 years.
- Class 5/Excellent: A well-designed project will have a payback of 12-15 years.
- Class 6/Outstanding: A well-designed project will have a payback of 10-12 years, but damaging high-wind events may be a concern.
- Class 7/Superb: Project developer may want to find a sheltered site to protect turbines from periodic damaging winds.

Set up a met tower

- 34-meter tower set up for at least one year.
- Wind speeds are generally higher in the winter and lower in the summer.
- Icing and turbulence can eliminate a potential site.



Set up a met tower

- Finding suitable anchors in permafrost, logging slash or rocky soils can be difficult.



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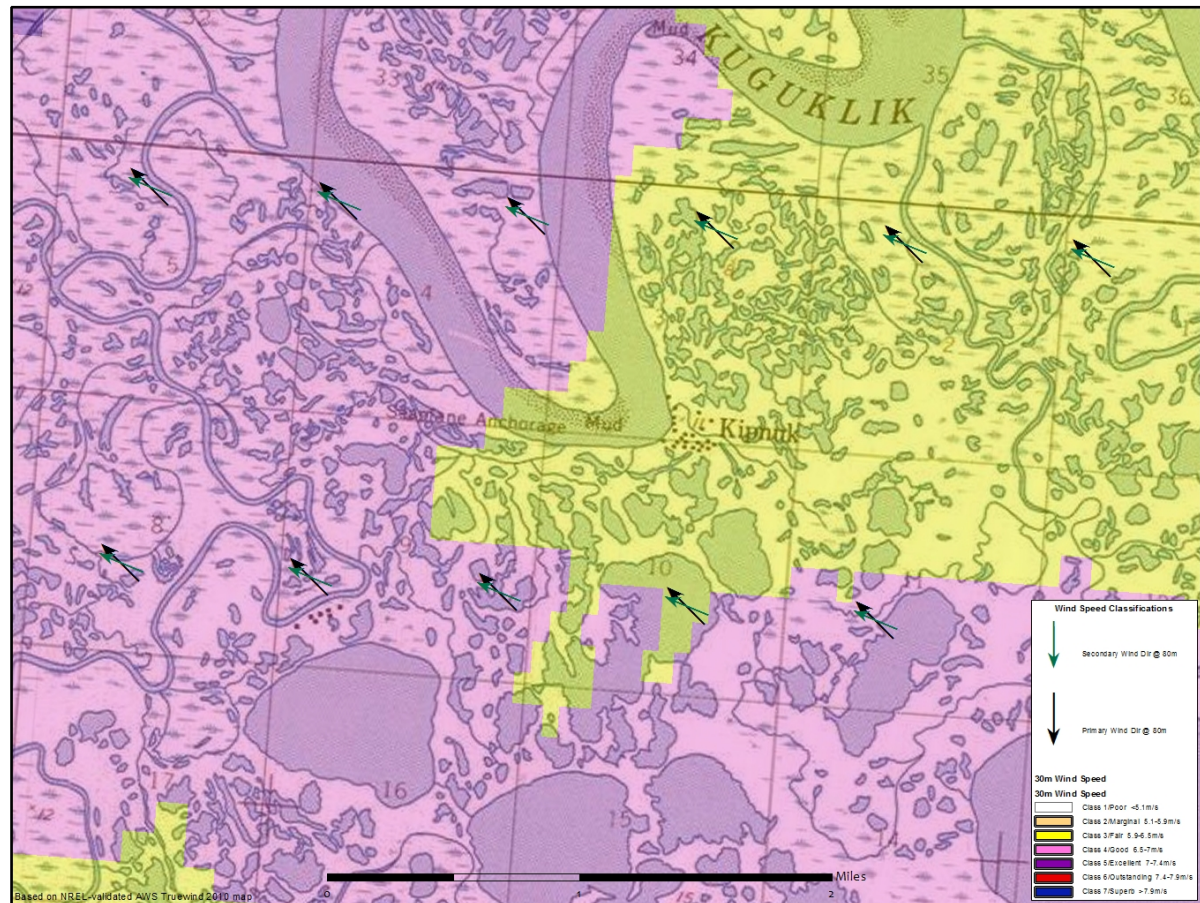


Siting your met tower

- Some communities have relatively consistent terrain

Kipnuk

AEA - Alaska Wind Speed Map

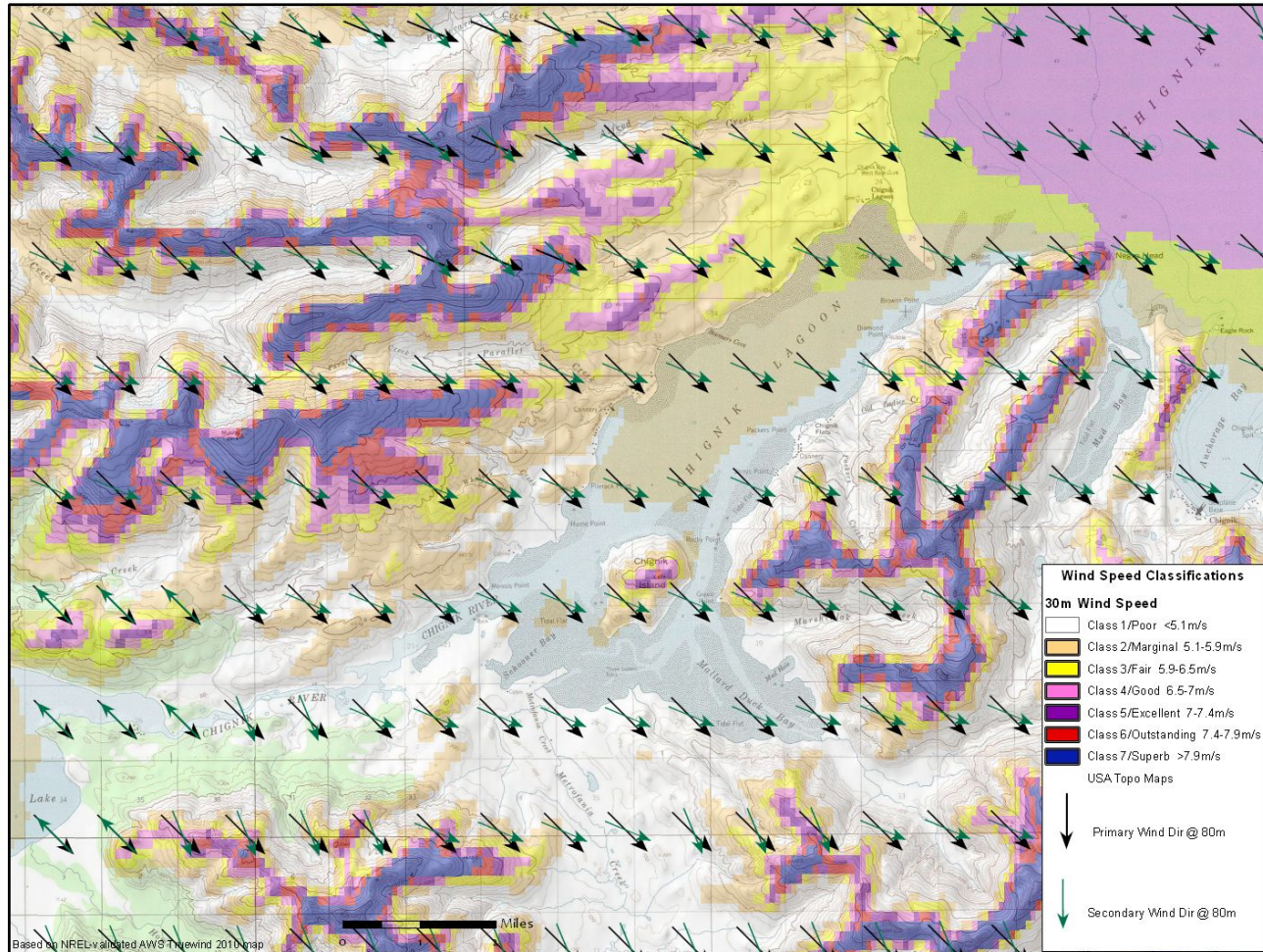


Siting your met tower

- Other communities have complex terrain

Chignik
Region

AEA - Alaska Wind Speed Map



Portable met towers

- Install multiple 10-meter towers simultaneously to identify the best location for a long term study
- Tower costs ~ \$1,000
- Weighs 75 lbs.
- Can be erected with two people and hand tools.



Project milestones *

- **Feasibility / \$120k-\$140k:**

- Purchase, ship and erect met tower
- Obtain site control, right of entry and permits for met tower
- Geotech site recon visit and report
- Dismantle met tower
- Draft and final wind and solar resource analysis
- Draft and final conceptual design report

- **Permitting/Design / ~\$250k**

- Permitting
- Negotiate site control
- Avian and other environmental analyses
- 65% Civil, Mechanical, and Electrical Design
- Revise Budget and Schedule

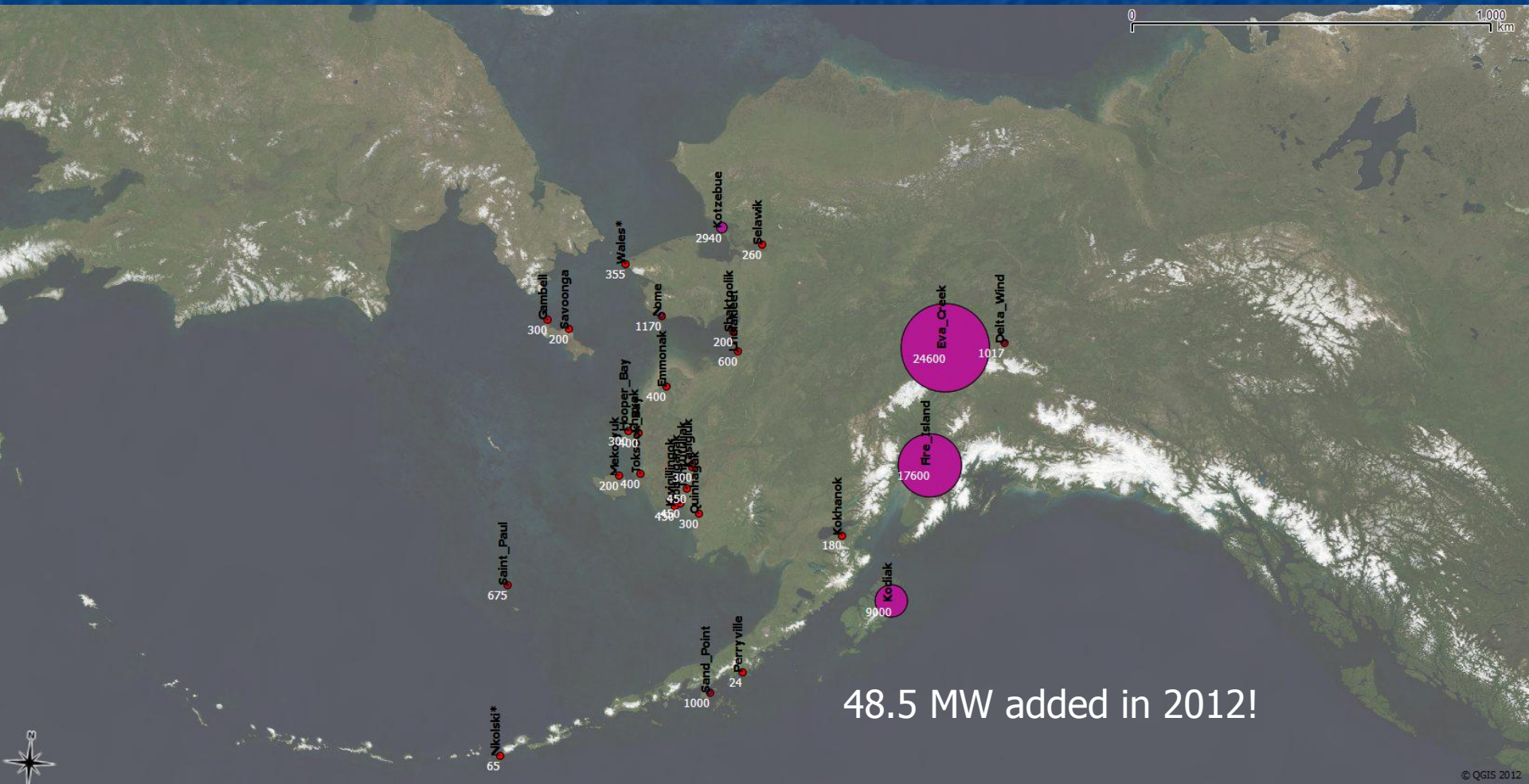
* This is the bare minimum. Some projects require additional steps.

Project sizing and economics

Penetration Class	Operating Characteristics	Penetration	
		Instantaneous	Average
LOW	<ul style="list-style-type: none"> • Diesel runs full-time • Wind power reduces net load on diesel • All wind energy goes to primary load • No supervisory control system 	< 50%	< 20%
MEDIUM	<ul style="list-style-type: none"> • Diesel runs full-time • At high wind power levels, secondary loads are dispatched to insure sufficient diesel loading or wind generation is curtailed • Requires relatively simple control system 	50% – 100%	20% – 50%
HIGH	<ul style="list-style-type: none"> • Diesels may be shut down during high wind availability • Auxiliary components are required to regulate voltage and frequency • Requires sophisticated control system 	100% – 400%	50% – 150%

- Projects that are too small won't take advantage of economies of scale.
- Projects that are too large may have excess power that never gets used.

Installed Wind Capacity – 63.8MW



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Задание 1. Прочитайте текст и выполните задания 1–4.

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Kotzebue EWT 900s + Battery

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PCE Impacts

GenBank Accession	Gene Name	Protein Name
U00096.1	ecpA	EcopA
U00096.1	ecpB	EcopB
U00096.1	ecpC	EcopC
U00096.1	ecpD	EcopD
U00096.1	ecpE	EcopE
U00096.1	ecpF	EcopF
U00096.1	ecpG	EcopG
U00096.1	ecpH	EcopH
U00096.1	ecpI	EcopI
U00096.1	ecpJ	EcopJ
U00096.1	ecpK	EcopK
U00096.1	ecpL	EcopL
U00096.1	ecpM	EcopM
U00096.1	ecpN	EcopN
U00096.1	ecpO	EcopO
U00096.1	ecpP	EcopP
U00096.1	ecpQ	EcopQ
U00096.1	ecpR	EcopR
U00096.1	ecpS	EcopS
U00096.1	ecpT	EcopT
U00096.1	ecpU	EcopU
U00096.1	ecpV	EcopV
U00096.1	ecpW	EcopW
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U00096.1	ecpB	EcopB
U00096.1	ecpC	EcopC
U00096.1	ecpD	EcopD
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U00096.1	ecpF	EcopF
U00096.1	ecpG	EcopG
U00096.1	ecpH	EcopH
U00096.1	ecpI	EcopI
U00096.1	ecpJ	EcopJ
U00096.1	ecpK	EcopK
U00096.1	ecpL	EcopL
U00096.1	ecpM	EcopM
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U00096.1	ecpO	EcopO
U00096.1	ecpP	EcopP
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U00096.1	ecpT	EcopT
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U00096.1	ecpX	EcopX
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U00096.1	ecpZ	EcopZ
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U00096.1	ecpC	EcopC
U00096.1	ecpD	EcopD
U00096.1	ecpE	EcopE
U00096.1	ecpF	EcopF
U00096.1	ecpG	EcopG
U00096.1	ecpH	EcopH
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U00096.1	ecpG	EcopG
U00096.1	ecpH	EcopH
U00096.1	ecpI	EcopI
U00096.1	ecpJ	EcopJ
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U00096.1	ecpN	EcopN
U00096.1	ecpO	EcopO
U00096.1	ecpP	EcopP
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U00096.1	ecpS	EcopS
U00096.1	ecpT	EcopT
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U00096.1	ecpV	EcopV
U00096.1	ecpW	EcopW
U00096.1	ecpX	EcopX
U00096.1	ecpY	EcopY
U00096.1	ecpZ	Ec

PCE Impacts

Phonetic transcription	IPA transcription	English transcription
ph	p d V	αph
ph	p o hr	α d V
ph	W r d	W d a r p 8
ph	c c c	α c r h d a c h 8
ph	u p p	α d p 3 h a d 8
ph	W a V	W d p a r 8
ph	h o r d	α u 3 c u a u 8
ph	c p c	α r h r
ph	s c u c	α u c V
ph	s c p	α u c
ph	s	α 3: W
ph	s	α p u d
ph	s	α W W
ph	s d c c	α c d
ph	s	α d p h
ph	s	α r r 3
ph	s	α d p h
ph	s	α h: u
ph	s	α d u
ph	s	α d 3
ph	ph	ph
ph	ph	ph
ph	ph	ph

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